

BRYAN MALDONADO

R&D Associate Staff, Oak Ridge National Laboratory

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🌐 [Personal webpage \(click\)](#)

Interests

My research focuses on model-based and model-free identification, estimation, and control of stochastic dynamic systems with an emphasis on machine learning and uncertainty quantification methods.

Control theory • statistical machine learning • stochastic dynamic programming • model-based optimal control • statistical signal processing • Bayesian statistical inference • propulsion systems • integrated energy systems

Education

2019 **PhD, Mechanical Engineering**, *University of Michigan*, Ann Arbor, MI

THESIS: *Stochastic Analysis and Control of EGR-Diluted Combustion in Spark Ignition Engines at Nominal and Misfire-Limited Conditions*. PDF: [📄](#)

ADVISOR: Prof. Anna Stefanopoulou

2016 **MS, Mechanical Engineering**, *University of Michigan*, Ann Arbor, MI

2014 **BS, Mechanical Engineering**, *Universidad San Francisco de Quito*, Quito, Ecuador

THESIS: *The Curvature Method Applied to Thermal Spray Coatings: Analytic Linear Elastic Analysis*. PDF: [📄](#)

ADVISOR: Prof. Alfredo Valarezo

2013 **BS, Mathematics**, *Universidad San Francisco de Quito*, Quito, Ecuador

THESIS: *The Fundamental Group of a Group Acting on a Topological Space*. PDF: [📄](#)

ADVISOR: Prof. John Skukalek

Research Experience

Oct. 2021 **Oak Ridge National Laboratory**, *R&D Associate Staff*, Oak Ridge, TN

to present Support control and machine learning-related projects at the National Transportation Research Center, Building Technologies Research and Integration Center, and Spallation Neutron Source

Jan. 2020 **Oak Ridge National Laboratory**, *Postdoctoral Research Associate*, Knoxville, TN

to Aug. 2021 Developed AI-based methods for next-cycle control of spark-ignition dilute combustion variability. Implemented model-free learning and control strategies using edge computing applied to propulsion systems

Sep. 2015 **Powertrain Control Laboratory**, *Graduate Research Assistant*, Ann Arbor, MI

to Dec. 2019 Developed a feedback combustion controller for spark-ignition engines to achieve high fuel efficiency where combustion instability is an issue. Implementation used MATLAB/Simulink on a field programmable gate array

Jan. 2019 **Army Research Laboratory**, *Center for UAS Propulsion*, *Journeyman Fellow*, Ann Arbor, MI

to Dec. 2019 Developed a feedback combustion control strategy for variable energy-assisted compression ignition engine for multi-fuel operation capability by adjusting the injection profile and glow plug temperature

Summer 2018 **Argonne National Laboratory**, *Graduate Student Research Aide*, Lemont, IL

Characterized cycle-to-cycle combustion variability at highly exhaust gas recirculation-diluted conditions. Looked for cycle-to-cycle and/or statistical metrics that can be used for combustion control

Summer 2014 **European Organization for Nuclear Research (CERN)**, *Research Assistant*, Geneva, Switzerland

Performed algorithm optimization using parallel programming for the path reconstruction algorithm in the inner detector of the ATLAS experiment. Implemented the algorithm using C++11

Summer 2012 **Coordinated Science Laboratory**, *University of Illinois Urbana-Champaign*, *Research Assistant*, Urbana, IL

Developed an orbital estimation algorithm for satellite tracking using stochastic differential equations on Python. Collaborated with fellow researchers and shared results via GitHub

Teaching Experience

- Fall 2016 **University of Michigan, Graduate Student Instructor**, Ann Arbor, MI
- Fall 2017 Held office hours for the graduate course ME 569 (Advance Powertrain Control) with an enrollment of ~70
and Fall 2019 students per semester (Fall 2016, 2017, and 2019). Presented recitation sessions and guest lectures on topics related to idle speed control, air-to-fuel ratio control, and ignition control. Student evaluations (median): 4.8/5
- Aug. 2014 **Universidad San Francisco de Quito, Instructor**, Quito, Ecuador
to Aug. 2015 Taught introductory mathematics classes: "Pre-calculus for Science" and "Pre-calculus for Administration."
Taught "Technical Drawing" in the Mechanical Engineering Department. Tutored CERN candidates in the application process. Oversaw homework, exam, and project design.
- Aug. 2012 **Universidad San Francisco de Quito, Teaching Assistant**, Quito, Ecuador
to May 2014 Taught introductory mathematics classes: "Pre-calculus for Science" and "Pre-calculus for Administration."
Performed lecture design, exam design, and grading. Led recitation sessions for advanced courses in mathematics: "Linear Algebra," "Multivariable Calculus," and "Advanced Calculus"

Mentoring Experience

- 2021 to 2022 **Volunteer, Tennessee Science Bowl**, Knoxville, TN
Supported the execution of the TN Science Bowl by volunteering as scorekeeper. Interacted with high schoolers before the contest rounds through motivational conversations related to science and engineering careers
- 2021 **External Thesis Committee Member, Universitat Politècnica de València, CMT-Motores Térmicos**
Evaluated thesis *Development of Combustion Indicators for Control of Multi-Fuel Engines Based on New Combustion Concepts* for PhD candidate Irina Jimenez
- 2017 to 2018 **Undergraduate Student Mentor, University of Michigan**, Ann Arbor, MI
Worked closely with Alexander Eskenazi-Gold on the project *Implementation of Low Speed Pre-Ignition (LSPI) Detection Algorithm on a Real-Time Rapid Prototyping Engine Control Unit (ECU)*. Project was selected as winner of the 2018 ASME ICEF Undergraduate Student Presentation Competition

Selected Honors and Awards

- 2020 **"Your Science in a Nutshell" Lightning talk winner, Oak Ridge National Laboratory**
Awarded for the 2-minute talk "Learning from Chaos: Controlling Combustion Events in Gasoline Engines"
- 2019 **ORAU Journeyman Fellowship, US Army Research Laboratory**
\$42K fellowship to perform research in the project *Variable Energy Assisted Compression Ignition*
- 2018 **Tau Beta Pi Michigan Gamma Scholarship, Tau Beta Pi Engineering Honor Society**
\$500 awarded to students in engineering who demonstrate exemplary character, integrity, and excellence
- 2016 **Rackham Summer Award, Rackham Graduate School, The University of Michigan**
\$8K fellowship stipend to perform research during the summer at the Powertrain Control Laboratory
- 2014 **SENESCYT Scholarship, National Secretary of Science and Technology, Ecuador**
\$5K awarded to students involved in institutions of high prestige developing new technology (CERN in my case)
Honorable Mention, Iberoamerican Mathematics Olympiad Committee
- 2012 4th Iberoamerican Mathematics Olympiad, Guanajuato, Mexico
and 2010 Iberoamerican University Mathematics Olympiad, Rio de Janeiro, Brazil
- 2008 **Newton Scholarship, College of Engineering, Universidad San Francisco de Quito**
Awarded to senior high school students with excellence academic records to lower college tuition costs

Funding

- 2021 **Online Learning of Combustion Dynamics with Spiking Neural Networks, PI: Brian Kaul, \$190K**
Laboratory Directed Research and Development Seed Funding awarded by Oak Ridge National Laboratory to develop a portable edge CPU and an engine control strategy based on spiking neural networks to achieve model-free online learning of combustion cycle-to-cycle dynamics

Communication Skills

Podcast

July 2021 **ASME Dynamic Systems and Control Division podcast, Co-Host**
to Present Interview researchers in the area of control theory

Conference Talks

Apr. 2022	SAE World Congress Experience	<i>Detroit, MI</i>
Oct. 2021	ASME Internal Combustion Engine Fall Technical Conference	<i>Virtual</i>
May 2021	American Control Conference	<i>Virtual</i>
Apr. 2021	SAE World Congress Experience	<i>Virtual</i>
Oct. 2020	ASME Dynamic Systems and Control Conference	<i>Virtual</i>
Oct. 2019	ASME Internal Combustion Engine Fall Technical Conference	<i>Chicago, IL</i>
June 2019	Symposium for Combustion Control	<i>Aachen, Germany</i>
Nov. 2018	ASME Internal Combustion Engine Fall Technical Conference	<i>San Diego, CA</i>
Sept. 2018	IEEE Conf. on Powertrain Control, Simulation and Modeling	<i>Changchun, China</i>
June 2018	American Control Conference	<i>Milwaukee, WI</i>
Oct. 2017	ASME Internal Combustion Engine Fall Technical Conference	<i>Seattle, WA</i>
May 2017	American Control Conference	<i>Seattle, WA</i>

Poster Sessions

May 2019	Center for Unmanned Aircraft Systems (UAS) Propulsion General Meeting	<i>Chicago, IL</i>
March 2018	ARPA-E Energy Innovation Summit	<i>Washington, DC</i>
2016-2018	Engineering Graduate Symposium	<i>University of Michigan</i>

Invited Talks

April. 2022	Caterpillar Inc., Virtual Invited speaker for the control systems seminar. Title: "Online adaptive control strategies for optimizing internal combustion engines"
Nov. 2021	Edge AI Summit, Virtual Keynote speaker at the 4th annual Edge AI Summit as part of a series of case studies about edge AI applications. Title: "Spiking Neural Network-Based Control for Improving Gasoline Engine Efficiency"
May 2021	Universidad San Francisco de Quito, Departamento de Ingeniería Mecánica, Quito, Ecuador Plenary speaker at the "Mech-Talks: Avances de la Ingeniería en Ecuador" held during the annual engineering open house. Title: "El rol de la inteligencia artificial en el consumo energético del sector de transporte" [The role of artificial intelligence in energy consumption of the transport sector]
June 2019	Universitat Politècnica de València, CMT-Motores Térmicos, Valencia, Spain Invited to give a seminar talk at the CMT-Motores Térmicos institute. Title: "Satisfying Unstable Combustion Limits in SI Engines at EGR Diluted Conditions: A Learning Reference Governor Approach"
Oct. 2014	Stony Brook University, Center for Thermal Spray Research, Stony Brook, NY Invited to present undergraduate thesis, <i>The Curvature Method Applied to Thermal Spray Coatings</i> , to establish a partnership between Stony Brook and the Universidad San Francisco de Quito
Sept. 2014	XIV Encuentro de Matemáticas y sus Aplicaciones, Quito, Ecuador Invited to present undergraduate thesis, <i>The Fundamental Group of a Group Acting on a Topological Space</i> , as part of the biennial conference dedicated to modern topics in mathematics

Programming Skills

MATLAB (including Machine Learning toolbox), Simulink, Python, LabVIEW, AVL Indimaster, Microsoft Office, L^AT_EX, C/C++, Linux, AVL Puma, AutoCAD, GitLab

Academic Service

Reviewer

- *IEEE Transactions on Control Systems Technology*
- *IEEE/ASME Transactions on Mechatronics*
- *ASME Journal of Dynamic Systems, Measurement and Control*
- *International Journal of Engine Research*
- *IFAC Control Engineering Practice*
- IEEE American Control Conference
- ASME Internal Combustion Engine Fall Technical Conference
- ASME Dynamic Systems and Control Conference
- IFAC International Symposium on Advances in Automotive Control
- SAE World Congress Experience

Technical Committee Member

- ASME Dynamic Systems and Control Division Automotive and Transportation Systems Technical Committee
- IEEE Control Systems Society Technical Committee on Automotive Controls

Professional Society Affiliations

Since 2014	Ecuadorian Mathematical Society	<i>Board member in 2014</i>
Since 2015	Society of Hispanic Professional Engineers	<i>Professional development chair in 2016</i>
Since 2016	Tau Beta Pi (Engineering Honor Society)	<i>Social co-chair in 2017</i>
Since 2018	IEEE, SAE, and ASME	<i>Member</i>

Publications

Book Chapters

- [Ch1] **B. P. Maldonado**, A. G. Stefanopoulou, and B. C. Kaul. Artificial-intelligence-based prediction and control of combustion instabilities in spark-ignition engines. In J. Badra, P. Pal, Y. Pei, and S. Som, editors, *Artificial Intelligence and Data Driven Optimization of Internal Combustion Engines*, pages 185–212. Elsevier, 2022. doi:10.1016/B978-0-323-88457-0.00006-0

Patents

- [P1] **B. P. Maldonado**, B. C. Kaul, C. D. Schuman, J. P. Mitchell, and S. R. Young. Dilute Combustion Control Using Spiking Neural Networks, US Provisional Patent 63235241, Aug. 2021

Journal Publications

- [J1] **B. P. Maldonado**, B. C. Kaul, C. D. Schuman, and S. R. Young. Reinforcement Learning Applied to Dilute Combustion Control for Increased Fuel Efficiency. *IEEE Transactions on Neural Networks and Learning Systems*, 2022. Under review
- [J2] **B. P. Maldonado**, B. C. Kaul, C. D. Schuman, S. R. Young, and J. P. Mitchell. Next-Cycle Optimal Dilute Combustion Control via Online Learning of Cycle-to-Cycle Variability using Kernel Density Estimators. *IEEE Transactions on Control Systems Technology*, pages 1–17, 2022. doi:10.1109/TCST.2022.3149423
- [J3] **B. P. Maldonado** and B. C. Kaul. Evaluation of Residual Gas Fraction Estimation Methods for Cycle-to-Cycle Combustion Variability Analysis and Modeling. *International Journal of Engine Research*, 23(2):198–213, 2022. doi:10.1177/1468087420983087

- [J4] **B. P. Maldonado**, B. C. Kaul, C. D. Schuman, S. R. Young, and J. P. Mitchell. Next-Cycle Optimal Fuel Control for Cycle-to-Cycle Variability Reduction in EGR-Diluted Combustion. *IEEE Control Systems Letters*, 5(6):2204–2209, 2021. doi:10.1109/LCSYS.2020.3046433
- [J5] Y. Luo, **B. P. Maldonado**, S. Liu, C. Solbrig, D. A., and A. Stefanopoulou. Portable In-Cylinder Pressure Measurement and Signal Processing System for Real-Time Combustion Analysis and Engine Control. *SAE Int. J. Adv. & Curr. Prac. in Mobility*, 2(6):3432–3441, 2020. doi:10.4271/2020-01-1144
- [J6] **B. P. Maldonado**, N. Li, I. Kolmanovsky, and A. G. Stefanopoulou. Learning reference governor for cycle-to-cycle combustion control with misfire avoidance in spark-ignition engines at high exhaust gas recirculation–diluted conditions. *International Journal of Engine Research*, 21(10):1819–1834, 2020. doi:10.1177/1468087420929109
- [J7] **B. P. Maldonado**, K. Zaseck, E. Kitagawa, and A. G. Stefanopoulou. Closed-Loop Control of Combustion Initiation and Combustion Duration. *IEEE Transactions on Control Systems Technology*, 28(3):936–950, 2020. doi:10.1109/TCST.2019.2898849
- [J8] **B. P. Maldonado**, M. Bieniek, J. Hoard, A. G. Stefanopoulou, B. Fulton, and M. Van Nieuwstadt. Modelling and estimation of combustion variability for fast light-off of diesel aftertreatment. *International Journal of Powertrains*, 9(1-2):98–121, 2020. doi:10.1504/IJPT.2020.108423
- [J9] **B. P. Maldonado** and A. G. Stefanopoulou. Cycle-to-Cycle Feedback for Combustion Control of Spark Advance at the Misfire Limit. *Journal of Engineering for Gas Turbines and Power*, 140(10):102812–102812–8, 2018. doi:10.1115/1.4039728
- [J10] H. Lian, J. B. Martz, **B. P. Maldonado**, A. G. Stefanopoulou, K. Zaseck, J. Wilkie, O. Nitulescu, and M. Ehara. Prediction of Flame Burning Velocity at Early Flame Development Time With High Exhaust Gas Recirculation and Spark Advance. *Journal of Engineering for Gas Turbines and Power*, 139(8):082801–082801–9, 2017. doi:10.1115/1.4035849
- [J11] **B. P. Maldonado** and J. R. Skukalek. The Fundamental Group of a Group Acting on a Topological Space. *Avances en Ciencias e Ingenierías*, 6(1):A10–A18, 2014. doi:10.18272/aci.v6i1.148

Conference Publications

- [C1] **B. P. Maldonado**, N. W. Hayes, D. Howard, and D. Hun. Automatic Segmentation of Building Envelope Point Cloud Data Using Machine Learning. In *Buildings XV Conference*, 2022. Under review
- [C2] **B. P. Maldonado**, B. C. Kaul, and J. Szybist. Artificial Neural Networks for In-Cycle Prediction of Knock Events. In *SAE Technical Paper 2022-01-0478*. SAE International, 03 2022. doi:10.4271/2022-01-0478
- [C3] C. D. Schuman, S. R. Young, **B. P. Maldonado**, and B. C. Kaul. Real-Time Evolution and Deployment of Neuromorphic Computing at the Edge. In *12th International Green and Sustainable Computing Workshop (IGSC)*, pages 1–8, 10 2021. doi:10.1109/IGSC54211.2021.9651607
- [C4] **B. P. Maldonado**, B. C. Kaul, C. D. Schuman, S. R. Young, and J. P. Mitchell. Dilute Combustion Control Using Spiking Neural Networks. In *SAE Technical Paper 2021-01-0534*. SAE International, 03 2021. doi:10.4271/2021-01-0534
- [C5] C. D. Schuman, S. R. Young, J. P. Mitchell, J. T. Johnston, D. Rose, **B. P. Maldonado**, and B. C. Kaul. Low Size, Weight, and Power Neuromorphic Computing to Improve Combustion Engine Efficiency. In *11th International Green and Sustainable Computing Workshop (IGSC)*, pages 1–8, 10 2020. doi:10.1109/IGSC51522.2020.9291228
- [C6] **B. P. Maldonado** and B. C. Kaul. Control-oriented modeling of cycle-to-cycle combustion variability at the misfire limit in si engines. In *ASME 2020 Dynamic Systems and Control Conference*, page V002T26A001, 10 2020. doi:10.1115/DSCC2020-3255
- [C7] M. Bieniek, **B. P. Maldonado**, A. G. Stefanopoulou, and J. Hoard. Online Control of Process Variance Using Feedback. In *2020 American Control Conference (ACC)*, pages 3589–3594, 07 2020. doi:10.23919/ACC45564.2020.9147900

- [C8] E. R. Amezcua, **B. P. Maldonado**, D. Rothamer, K. Kim, C. Kweon, and A. G. Stefanopoulou. Accelerometer-Based Estimation of Combustion Features for Engine Feedback Control of Compression-Ignition Direct-Injection Engines. In *SAE Technical Paper 2020-01-1147*, 03 2020. doi:10.4271/2020-01-1147
- [C9] **B. P. Maldonado**, A. G. Stefanopoulou, R. Scarcelli, and S. Som. Characteristics of Cycle-to-Cycle Combustion Variability at Partial-Burn Limited and Misfire Limited Spark Timing Under Highly Diluted Conditions. In *ASME 2019 Internal Combustion Engine Division Fall Technical Conference*, page V001T03A018, 10 2019. doi:10.1115/ICEF2019-7256
- [C10] **B. P. Maldonado**, C. E. Solbrig, and A. G. Stefanopoulou. Feasibility and Calibration Considerations for Selection of Combustion Control Features. In *2019 IEEE Conference on Control Technology and Applications (CCTA)*, pages 412–417, 08 2019. doi:10.1109/CCTA.2019.8920631
- [C11] M. Bieniek, A. Stefanopoulou, J. Hoard, **B. P. Maldonado**, B. Fulton, and M. Van Nieuwstadt. Retard to the Limit: Closed-Loop COVIMEP Control for Aggressive Exhaust Heating. *IFAC-PapersOnLine*, 52(5):624–629, 06 2019. 9th IFAC Symposium on Advances in Automotive Control AAC 2019. doi:10.1016/j.ifacol.2019.09.099
- [C12] **B. P. Maldonado**, N. Li, I. Kolmanovsky, and A. G. Stefanopoulou. Satisfying Unstable Combustion Limits in SI Engines at EGR Diluted Conditions: A Learning Reference Governor Approach. In *2019 Symposium for Combustion Control (SCC)*, pages 87–96. RWTH Aachen University, 06 2019
- [C13] **B. P. Maldonado** and A. G. Stefanopoulou. Non-Equiprobable Statistical Analysis of Misfires and Partial Burns for Cycle-to-Cycle Control of Combustion Variability. In *ASME 2018 Internal Combustion Engine Division Fall Technical Conference*, page V002T05A003, 11 2018. doi:10.1115/ICEF2018-9540
- [C14] **B. P. Maldonado** and A. G. Stefanopoulou. Linear Stochastic Modeling and Control of Diluted Combustion for SI Engines. *IFAC-PapersOnLine*, 51(31):99–104, 09 2018. 5th IFAC Conference on Engine and Powertrain Control, Simulation and Modeling E-COSM 2018. doi:10.1016/j.ifacol.2018.10.019
- [C15] **B. P. Maldonado**, J. S. Freudenberg, and A. G. Stefanopoulou. Stochastic Feedback Combustion Control at High Dilution Limit. In *2018 Annual American Control Conference (ACC)*, pages 1598–1603, 06 2018. doi:10.23919/ACC.2018.8431020
- [C16] **B. P. Maldonado**, H. Lian, J. B. Martz, A. G. Stefanopoulou, K. Zaseck, and E. Kitagawa. Combustion shaping using multivariable feedback control. In *2017 American Control Conference (ACC)*, pages 4760–4765, 05 2017. doi:10.23919/ACC.2017.7963691